Proven DryCal® TECHNOLOGY

ML-1500

User Manual

NVLAP®

NVLAP Lab Code 200661-0

MesaLabs

MesaLabs

Mesa Labs' Commitment

As a manufacturer of critical equipment, quality is the highest priority in our manufacturing process. Mesa Labs commits to providing creative, innovative thinking and the engineering and scientific expertise needed to produce gas flow-related products and solutions that are universally recognized for their superior performance, quality and value.

Proven DryCal technology is the recognized leader in gas flow measurement, providing the industry's most reliable products, service and solutions for professionals in environmental protection, workplace safety, industrial process control and laboratory calibration.

We strive to provide the closest NIST-traceable, legal defensibility of any flow calibration equipment manufacturer, and we actively maintain our NVLAP (NIST) ISO 17025 laboratory accreditation in order to support our claims and continually improve our quality system and laboratory proficiency. Thank you for purchasing our products. From all of us at Mesa Labs, best wishes for many years of accurate, defensible primary flow measurements.

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- Accuracy
- Reliability
- Convenience

Introduction

Congratulations! You've chosen the Met Lab 1500 primary gas flow standard, featuring Proven DryCal® Technology. The innovative Met Lab 1500 is a precise primary gas flow calibrator engineered for the calibration of high flow meters, within a space-saving, transportable design.

Before you get started, please take a few moments to review this manual and familiarize yourself with your Met Lab 1500. If at any time you have questions regarding its operation, please contact Mesa through www.drycal.com, or call us at 973.492.8400 to speak with one of our knowledgeable customer support representatives.

About Your Met Lab 1500

Like all Mesa primary standards, the Met Lab 1500 is a positive displacement primary piston prover for gas flow measurements in either pressure or suction applications. Using patented Proven DryCal® Technology, it combines the accuracy of a primary calibrator with unequaled speed and convenience, providing gas flow measurements at the push of a button.

An excellent tool for the calibration of instruments that read in mass flow, your Met Lab 1500 measures flow from 15 SLPM (Standard Liters Per Minute) to 1500 SLPM within an accuracy of ±0.4% of reading. Flow measurements can be taken manually (one reading at a time), or automatically in the continuous mode, with up to 100 measurements in an averaging sequence.

All DryCal flow calibrators are generally designed to be at ambient pressure. The DryCal's outlet or inlet is vented to atmosphere based on the application. The outlet of the DryCal is required to be open to atmosphere while the inlet is connected to a pressure source or the inlet needs to be open to atmosphere while the outlet is connected to a suction flow source. The physical dimensions of piston prover pose a limit to measure volumetric flow above a certain range. However, to measure a higher gas flow, a piston prover can be subjected to a higher pressure so it does not exceed the mechanical limitation and can be converted to a higher standardized flow using the ideal gas law. This same principle has been applied in designing the ML-1500. Unlike other DryCal piston provers, the ML-1500 is designed to be used in-line at a maximum rated pressure of 45 psia to achieve 1500 slpm (standardized to 760 mmHg and 21.1 deg C).

For your convenience, your Met Lab 1500 features an LCD display screen with magnification option, an On/Off button on the front panel, and a convenient touch pad control to enable you to quickly access various menu options and many user-definable settings. Menu navigation is intuitive, controlled by the right, left, up and down arrows on the touch pad.

For information regarding the metrology behind your Met Lab 1500, referred to as Proven DryCal® Technology, please visit our web site, at www.drycal.com.

Your Met Lab 1500 also includes an RS-232 port and serial cable. You can also utilize Mesa's DryCal Pro software package available for download from http://drycal.mesalabs.com/drycal-pro-software/.

DryCal Pro software captures flow data from your DryCal® instrument for easy export into common software packages.

- Capture flow data from your DryCal® directly to a PC and export the data to a Microsoft environment.
- Real-time data monitoring
- Enter flow rates from pumps or other flow source and calibrate the flow source.
- Enter flow data from a flow meter and compare the flow measurements from your DryCal® precision calibrator.
- Upload the latest version of the firmware to your DryCal®.

Unpacking Your Met Lab 1500

Your Met Lab 1500 is a laboratory primary standard, and has been shipped in Mesa's rugged, reusable shipping container.

The Met Lab 1500 weighs 90 lbs / 41 kilograms. Unpacking by two people is recommended. The Met Lab 1500 can be lifted from the shipping container by verifying the nuts on the large inlet and outlet fittings are tight and lifting the Met Lab 1500 by grasping these fittings. While lifting the Met Lab 1500 from the shipping container, the top of the Met Lab 1500 should be supported to prevent tipping.

Your Met Lab 1500 comes with the following:

- AC Power Adapter
- PC Serial Cable (RS-232)
- Calibration Certificate
- Reusable shipping container

Warnings

- The Met Lab 1500 is not intrinsically-safe and is not for use with explosive or flammable gases, or for use in explosive environments. If you choose to calibrate explosive or flammable gases with your Met Lab 1500, please follow your organization's laboratory safety procedures, which typically require operation within an inert atmosphere. To enable use in an inert atmosphere, your Met Lab 1500 has two (2) ¼" gas Purge fittings, located on its right side, and its electronics are isolated from the gas flow stream, contained within an internal, partitioned compartment.
- The Met Lab 1500 is not designed to be pressurized above 50 psiA or for gas flows above 1500SLpm. If pressurization reaches 49 psiA, the following warning will appear on the display on the main control panel: OVERPRESSURE! If this occurs, remove the overpressure situation, then choose "Reset" from the LCD display to clear this warning.
- The Met Lab 1500 does not contain user-serviceable parts and must be returned to Mesa for maintenance.

Operating Your Met Lab 1500

Connections

Your Met Lab 1500 should be placed on a steady, secure work surface. For optimum stability, the Met Lab 1500 has self adjusting feet at its base.

Locate both the Inlet (pressure) and Outlet (suction) fittings (see Figure 1) and remove their protective caps.

You're now ready to make the following connections (as needed), using Figures 1 and 2 as reference:

Power

Plug your AC power adapter (supplied) into an AC wall outlet, and attach its DC output cord to your ML-1500's rear DC Power 12VDC, 3A connection.

Valve Actuation Air Source

Your ML-1500's internal valve actuates by air pressure, and must be connected to a filtered oil free air source of at least 80 psi (5516 mbar) and no higher than 100 psi (6895 mbar). Using tubing (not supplied) and the 1/4" (6.35mm) Swagelok Valve Actuation Fitting on the rear of the unit, connect your laboratory air to your ML-1500. Turn on the air source, and verify that the pressure is between 80 and 100 psi (5516 and 6895 mbar) (pressure gauge not supplied).

Inlet (Pressure) and Outlet (Suction) Fittings

Your ML-1500 contains 1.5" (38.1 mm) of Swagelok® fittings both at the pressure and suction. Connect the gas flow to your ML-1500 as per the recommended application set up on page 7.

Overpressure Exhaust

When your ML-1500 completes a flow measurement, its internal valve opens, releasing the gas from the flow cell and enabling the piston to drop to the bottom (reset). If for any reason the valve doesn't open, the piston will move to the top of the flow cell and a safety switch will automatically reset the ML-1500. If for any reason the valve doesn't open, the piston will remain at the top of the flow cell and pressure will build. To prevent over-pressurization of the flow cell, your ML-1500 has an overpressure sensor that will reset the unit. Additionally the ML-1500 has a mechanical pressure relief valve that exhausts the gas if over pressurization occurs through a ½" Swagelok® fitting (Overpressure exhaust). If this fitting is currently open to ambient and you don't want the gas to vent to atmosphere, you should connect a direct line from this fitting to your exhaust system; or, if your ML 1500 is already directly connected to your exhaust system, you can "tee" a line from the Overpressure Exhaust fitting to your exhaust line.

Purge Fittings

Your ML-1500 is not intrinsically-safe for use with explosive or flammable gases (see About Your ML-1500 – Warnings). If you choose to calibrate explosive or flammable gases with your ML-1500, please follow your organization's laboratory safety procedures, which typically require operation within an inert atmosphere. To enable use in an inert atmosphere, your ML-1500 has two (2) ¼" (6.25 mm) gas Purge fittings, located on its right side, and its electronics are isolated from the gas flow stream, contained within an internal, partitioned compartment.

Please note that electric current is still present within your ML-1500's gas flow stream, at the pressure sensor and temperature transducer.

Figure 1: Front View, ML 1500

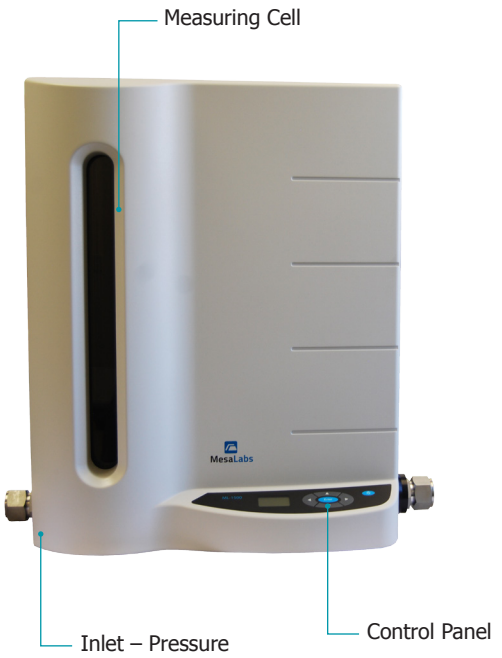
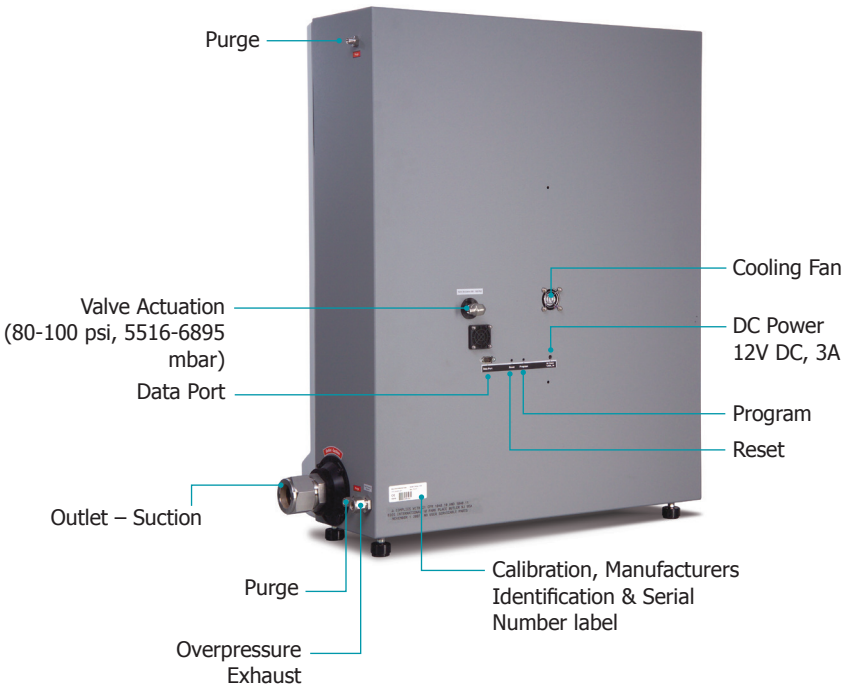


Figure 2: Rear View, ML 1500



Getting Started

To turn on your ML-1500, press the On/Off button in the lower right corner of the control panel for one second. To turn it off, press and hold the On/Off button for three seconds.

When turned on, your ML-1500's LCD displays an opening screen indicating the product name, model number and flow range, and its cooling fan will turn on.

Navigating through your ML-1500's menu screens is easy and intuitive – simply use the four directional arrows on the control panel for toggling between menu options (right, left, up, down). Your location within each menu or menu item is highlighted (shaded). A menu item in angle brackets (< >) indicates that multiple options exist for that item; these options are displayed when that item is selected. To select highlighted or bracketed items, press ENTER at the center of the navigational display on the control panel.

When you're ready, visit the SETUP menu and take some time to explore your ML-1500's many user-definable settings (see Setup).

Customizing Your Calibration

Your ML-1500's calibrations may be customized and automated for your convenience. To customize each option, move between menu selections using the up and down arrows. When a selection is highlighted, use the right and left arrows to toggle between your choices for that selection. Press CONFIRM to save any changes and return to SETUP, or press EXIT to return to SETUP without saving any changes.

Setup

From the initial screen, choosing SETUP gives you access to many customizable options. If at any time you'd like to return your ML-1500 to its factory default settings, navigate to Preferences, set Default Settings to "Yes" and then Confirm the changes. In each setup sub-menu, selecting CONFIRM applies the settings and returns to the main setup menu. Selecting EXIT returns to the main menu retaining the settings as they were originally.

READINGS. Select Volumetric flow or Standardized flow (volumetric flow corrected to specified temperature and pressure conditions, for calibrating instruments that read in mass flow, such as MFCs). Choose your preferred number of measurements in the average, from 1 to 100. If you'd like a delay between flow measurements (i.e., in order to time-profile MFCs to verify their long-term performance), set the "Time Between" from 1 to 60 minutes. As applicable, change the Sensor Factor from its default value of 1.000 to the value provided by the MFC or MFM manufacturer (see Using Sensor Factors).

UNITS. Depending on whether you've selected Volumetric or Standardized flow in the Readings menu, you may view flow measurements in liters or cubic feet (all units are per minute). Choose to view pressure in mmHg, kPa or psi, and choose to view temperature in Celsius or Fahrenheit. If you're measuring standardized flow, enter the temperature to which the gas flow volume will be standardized depending on the application. Pressure standardization is not adjustable, and is always 101.325 kPa, 760 mmhg, or 14.696 PSI of absolute pressure.

TIME. Set the current time in the format you prefer.

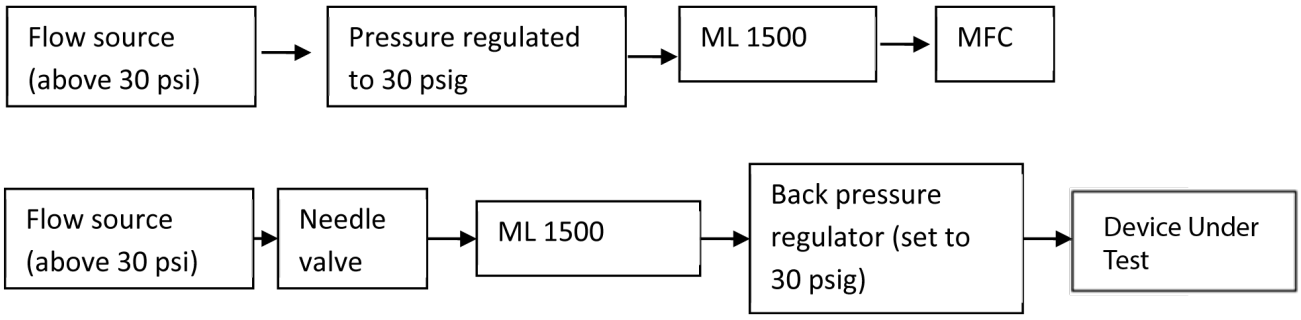
DATE. Set the month/date/year in the format you prefer.

PREFERENCES. Read Default offers a choice of Single, Continuous or Burst measurements; choose the type of flow measurement you will normally use. Once selected, your ML-1500 always defaults to this setting when Measure is selected. Default Settings allows you to reset your ML-1500 to the factory defaults. Magnification controls the amount of data on the display; choose Zoom to view only flow measurements in larger font, or choose Detail to simultaneously view flow measurements, temperature conditions, pressure conditions, and sensor factor in smaller font.

ABOUT. Tells you more about your ML-1500, a useful screen to refer to when speaking with a Mesa technical support representative or your Mesa sales representative.

Application Setup

Below are two application setups that can be followed to measure gas flow using ML-1500.



Taking Measurements

Once you've finished customizing your ML-1500's SETUP and have confirmed your changes, select MEASURE to begin a set of measurements. MEASURE gives you access to the main menu, where you can choose between the following flow measurement options:

- Single. Each time the "Enter" button is pressed, one measurement is taken.
- Cont. When the "Enter" button is pressed, measurements continue automatically until stopped by the user.
- Burst. A single series of measurements is taken until the number of readings in the average is met.

To take a flow measurement, select the type of flow measurement you want, and then press ENTER. Your ML-1500 will begin talking flow measurements. When taking flow measurements, the previous measurement, the running average of all measurements and the number of measurements in the average are provided simultaneously. The flow-cell viewing window lights each time the piston rises, and you will hear the internal valve clicking open and closed at the beginning and end of each flow measurement.

You can stop flow measurements at any time by choosing either PAUSE or RESET. PAUSE terminates the flow measurement but leaves the flow results on the screen and returns to the measurement menu. The set of measurements may be resumed where they were stopped by selecting SINGLE, CONT., or BURST . You may switch between continuous and burst modes at will but once single readings are selected RESET must be selected once or twice to return to the measurement menu to choose continuous or burst modes. RESET clears the screen, resets the average counter to 0, and returns to the measurement menu.

From the measurement menu, selecting EXIT returns the main menu. Choosing SETUP in the main menu allows you to further customize your ML-1500's operation.

Using Sensor Factors

Your ML-1500 is factory-calibrated with nitrogen or purified laboratory air, although you can run other gases, provided they are noncorrosive, noncondensing and noncombustible (like most primary standards, your ML-1500 is not intrinsically-safe).

When calibrating an MFC or MFM using a surrogate or proxy gas (meaning the MFC or MFM was originally calibrated by the manufacturer for a gas other than what you are currently using), refer to the manufacturer's sensor factor.

To enable your ML-1500 to scale its actual flow measurements to match the adjusted flow from the MFC or MFM, input the sensor factor into the ML-1500 before calibrating the MFC or MFM (see SETUP – Readings).

Because a sensor factor other than your ML-1500's default value of 1.000 modifies the actual flow to a "reported" flow, an exclamation mark (!) will appear next to any ML-1500 measurement that is being adjusted according to a sensor factor when your display is set to Zoom (see SETUP, Preferences, Magnification). If your display is set to Detail, then no exclamation point appears. Rather, the sensor factor (SF) will be displayed, along with its value on the measurements screen along with the individual flow measurements.

Notes

Out of Range!

If your Device Under Test is generating more flow than your ML-1500's rated flow range of 500 liters per minute (**volumetric**), the "Out of Range!" warning appears when you attempt to take a flow measurement. Immediately lower or disconnect the flow source. When the flow is within the proper range, either choose "Reset" from the LCD display to clear the last measurement, or try to take another flow measurement.

You may verify your ML-1500's flow range by navigating to SETUP, then About.

Over Pressure!

If your ML-1500 has an internal pressure that is greater than 49 psiA, the "Over Pressure!" warning appears. This can occur before or during a flow measurement. If the ML-1500 is in the process of taking a flow measurement, the unit will open the valve; the piston will reset, and the "Over Pressure!" warning will be displayed. You will need to reduce the pressure to the unit before initiating a measurement.

Program

The recessed Program button, located on the rear of your ML-1500, enables firmware updates. To update your ML-1500's firmware (available from our website www.mesalabs.com), connect your serial cable (supplied) to your ML-1500's RS-232 serial port and to the serial port of your PC, then hold the Program button down while pushing the recessed Reset button, also on the rear of your ML-1500.

Reset Function

If your ML-1500 fails to respond to push-button commands, try resetting the unit by pressing the reset button on the back. This can be done easily with a bent paper clip. Please note that resetting your ML-1500 will not affect your user settings. However, if you are in the middle of a calibration, your ML-1500 will return to the initial measurement phase and you'll need to initiate a new flow measurement.

Storage

To store your ML-1500 for an extended period, please follow these guidelines:

- Always store it in a clean, dry place
- Disconnect your lab's air supply from its Valve Actuation fitting
- Cap its Inlet and Outlet fittings

Accessory Items

These inlet/outlet fitting adapters are available at an additional cost from Mesa. Please check with Mesa directly for updated information.

Part Number	Description
100-436	Swagelok reducer used to reduce from a 1 1/2" Swagelok fitting to 1" tube OD, includes Nut and Ferrule Set 1 1/2”
100-437	Swagelok reducer used to reduce from a 1" Swagelok fitting to 3/4" tube OD
100-438	Swagelok reducer used to reduce from a 1" Swagelok fitting to 1/2" tube OD
100-439	Swagelok Nut and Ferrule Set 1 1/2"
100-440	Swagelok Nut and Ferrule Set 1"
100-441	Swagelok Nut and Ferrule Set 3/4"
100-442	Swagelok Nut and Ferrule Set 1/2"

Annual Maintenance and Calibration

Your ML-1500 is engineered to provide years of reliable service, with appropriate care and maintenance. Mesa recommends annual calibration by an ISO 17025-accredited laboratory, such as Mesa's Butler, NJ location, to help ensure the best possible flow measurements, meet regulatory requirements and provide a bulletproof audit trail in the event of litigation. Should you encounter any problems with your ML-1500, immediately contact Mesa Customer Service.

Recertification

Your ML-1500 is a precision measuring standard with moving parts machined to extremely close tolerances. Various environmental factors, product wear, drift of the temperature sensors and pressure transducers or inadvertent damage may adversely affect your ML-1500's measurement accuracy or general performance.

For these reasons, we highly recommend having your ML-1500 annually verified and serviced by our experienced personnel in our accredited ISO 17025 metrology laboratory, located in New Jersey, USA. For those applications subject to regulatory or ISO requirements, verification by our accredited laboratory provides you with assurance of measurement integrity. Please note that while many accredited gas flow measurement laboratories may be capable of properly verifying the accuracy of your ML-1500, Mesa is the only authorized service center in the USA for DryCal Met Lab products.

Our elective Recertification program is a complete product service package that provides pre-calibration at significant flow points; complete product refurbishment, testing, and available upgrades; post-calibration at significant flow points; and NIST-traceable Mesa calibration certificates backed by our accreditation to ISO 17025, ANSI Z-540, and NIST Handbook 150 quality standards. Recertification includes a 90-day service warranty should any related labor or parts replacements prove faulty.

Turnaround time is generally two to three weeks within Mesa from the date we received your ML-1500. To obtain current Recertification pricing, please contact Mesa at 973.492.8400, or visit our web site at drycal.mesalabs.com/request-an-rma/.

Sending Your ML-1500 to Mesa

Please contact Mesa for an RMA (return merchandise authorization) number before sending your ML-1500 to our factory for elective Recertification or other service. You can get an RMA number through our automated web-based system at http://drycal.mesalabs.com/request-an-rma/, by email to csbutler@mesalabs.com, or by telephone at 973.492.8400. Sending your ML-1500 to Mesa without an RMA number may result in return of the instrument without inspection or a substantial delay in service turnaround time.

When requesting an RMA number, provide your ML-1500 serial number and revision level. Also describe any product issues you may be experiencing. Please keep in mind that Mesa will not begin evaluation and service of your ML-1500 until you have approved our formal RMA quote.

If sending your ML-1500 for repair or evaluation (rather than elective Recertification), please contact Mesa for technical support or troubleshooting assistance prior to shipping the unit. We will first attempt to resolve the situation over the phone or via email. If you've provided us with a detailed description of your ML-1500's issue and application details and we're unable to resolve the situation by phone or email, we'll issue you an RMA number for prompt return of your ML-1500 for evaluation.

Please note that Mesa will make every attempt to verify your issue, as we want you to get the most out of your ML-1500. However, if we are unable to detect a product issue or if we determine that the issue is application-related rather than product-related, we reserve the right to charge an evaluation fee.

Shipping

When shipping your ML-1500, please use the reusable shipping container that was supplied with your unit.

We highly recommend insuring the product against damage in transit, and using a standard freight carrier (e.g., FedEx, UPS) that provides tracking numbers and offers door-to-door delivery directly to Mesa. Please note that Mesa does not arrange, or pay for, shipment transfers from local airports to our facility, so we are not responsible for additional expense and transit time incurred through airport deliveries.

Mesa is not responsible for damage that may occur during shipment.

Met Lab 1500 Specifications

Measurements:

Flow range: 15 to 1500 SLPM

* At a gas pressure of 45 psia, and a gas temperature of 25° centigrade with standardization temperature set to 21.1° centigrade.

Accuracy, Volumetric & Standardized: ±0.40% of reading (15-30°C)

Time per Measurement: 5-100 seconds (approximate)

Measurement Type: Single, Continuous or Burst

Volumetric Flow Units: L/min, cf/min

Standard Flow Units: sL/min, scf/min

Pressure Units: mmHg, psi, kPa

Temperature Units: °C, °F

Basics:

Dimensions (H x W x D): 34 x 32 x 12 in / 86 x 81 x 30 cm

Weight: 90 lbs / 41 kg

Temperature & Pressure Sensors: In the flow stream

Temperature Accuracy: ±0.2 ˚C (±0.36 ˚F)

Pressure: 49 psiA maximum pressure

Pressure Accuracy: 0.05% FS

Power: 100-240V, 50-60Hz, 5 watts - external power module. (the power adapter accepts an IEC 60320 C13 connector for use with any AC Power interface)

Shop air for internal valve actuation: 80–100 psi (5516–6895 mbar), ¼" (6.35 mm) Swagelok® compression fittings

Inlet and Outlet Fittings: 1.5" (38.1 mm) Swagelok® compression fittings

Purge Fittings: ¼" (6.35 mm) Swagelok® compression fittings

Over Pressure Fitting: ½" (12.7 mm) Swagelok® compression fittings

Display: Backlit graphical LCD

Usage:

Flow Modes: Pressure or Suction

Gas Compatibility: Noncorrosive, noncondensing, noncombustible gases, <70% humidity

Operating Pressure (Absolute): 14-45 PSIA

Operating Temperature: 15-30° C

Ambient Humidity: 0–70%, non-condensing

Storage Temperature: 0–70° C

Warranty: 1 year

DryCal Pro Software:

Visit Mesa's website to download your copy of DryCal Pro software (http://drycal.mesalabs.com/drycal-pro-software/). DryCal Pro captures flow data from your ML-1500 directly to a pre-configured table. The data can be exported to selectable Microsoft office environment.

To run DryCal Pro, you must have Windows® XP or 7, Microsoft Excel® 2003 and up, and a RS232 port, or if your PC does not have an RS-232 port you will need a USB to RS-232 adapter.

Limited Warranty

The Met Lab 1500 is warranted to the original end user to be free from defects in materials and workmanship under normal use and service for a period of one year from the date of purchase as shown on the purchaser's receipt. If the unit was purchased from an authorized reseller, a copy of an invoice or packing slip showing the date of purchase may be required to obtain warranty service.

The obligation of Mesa Laboratories, Inc. under this warranty shall be limited to repair or replacement (at our option), during the warranty period, of any part that proves defective in material or workmanship under normal use and service, provided the product is returned to Mesa, transportation charges prepaid.

Notwithstanding the foregoing, Mesa Laboratories, Inc. shall have no liability to repair or replace any Mesa Labs product:

1. That has been damaged following sale, including but not limited to damage resulting from improper electrical voltages or currents, defacement, misuse, abuse, neglect, accident, fire, flood, terrorism, act of God or use in violation of the instructions furnished by Mesa Laboratories, Inc.;
2. When the serial number has been altered or removed; or
3. That has been repaired, altered or maintained by any person or party other than Mesa Labs' own service facility or a Mesa authorized service center, should one be established.

This warranty is in lieu of all other warranties and all other obligations or liabilities arising as a result of any defect or deficiency of the product, whether in contract or in tort or otherwise. All other warranties, expressed or implied, including any implied warranties of merchantability and fitness for a particular purpose, are specifically excluded.

In no event shall Mesa be liable for any special, incidental or consequential damages for breach of this or any other warranty, express or implied, whatsoever.

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